

New Lyriinae (Mollusca: Volutidae) from the Lower Miocene Cantaure Formation of Venezuela

Bernard LANDAU *

Centro de Geologia da Universidade de Lisboa. Campo Grande, 1749-016 Lisboa, Portugal and
International Health Centres, Av. Infante de Henrique 7, Areias São João, P-8200 Albufeira, Portugal
bernielandau@sapo.pt

Geerat J. VERMEIJ

Department of Geology, University of California at Davis, One Shields Avenue, Davis, CA 95616,
USA. vermeij@geology.ucdavis.edu

* Corresponding author

ABSTRACT. The subfamily Lyriinae (Volutidae) is recorded from the early Miocene Cantaure Formation of Venezuela for the first time. Two species are recorded: *Lyria gabbi* Vokes, 1998, which is also found in the Lower Miocene Baitoa Formation of the Dominican Republic, and *Enaeta inornata* n. sp.

KEYWORDS. Lyriinae, Mollusca, *Lyria*, *Enaeta*, Miocene, Cantaure Formation, Venezuela, new record, new species

INTRODUCTION

No species of Lyriinae Pilsbry & Olsson, 1954 were mentioned in Jung's (1965) systematic description of the Lower Miocene Cantaure Formation fossil molluscan assemblage on the Paraguaná Peninsula, Venezuela. This is hardly surprising, as both the species recorded here are extremely rare in these deposits. We discuss one new record of *Lyria* Gray, 1847 and describe a new species of *Enaeta* Adams & Adams, 1853 from the Cantaure Formation.

Material and Methods

The material described here is from the Gibson-Smith collection housed in the Naturhistorisches Museum Basel (NMB coll.), Switzerland and the Bernard Landau collection (BL coll.), now deposited in the Naturhistorisches Museum Wien (NHMW coll.), Vienna. We have examined other collections from this locality, and none contains any species of Lyriinae.

SYSTEMATIC PALAEONTOLOGY

CLASS GASTROPODA

SUPERFAMILY VOLUTOIDEA Rafinesque, 1815

Family VOLUTIDAE Rafinesque, 1815

Subfamily LYRIINAE Pilsbry & Olsson, 1954

Genus *Lyria* Gray, 1847

Type species (by original designation): *Voluta nucleus* Lamarck, 1811.

Lyria gabbi Vokes, 1998
Figs 1, 2

Lyria pulchella (Sowerby). Gabb 1873, p. 219 (in part; non G. B. Sowerby 1, 1850).

Lyria soror (Sowerby). Pilsbry 1922, p. 338, pl. 24, figs 11-12 (non G. B. Sowerby 1, 1850).

Lyria (Lyria) gabbi E. H. Vokes 1998, p. 11, pl. 1, figs 7-8.

Material and dimensions. Two specimens; larger, NHMW 2009z0079/0006 (ex BL coll.), height 33.7 mm; lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón, Venezuela (= locality GS12PGNA of Gibson-Smith & Gibson-Smith 1979) (1 other in BL coll.).

Discussion. *Lyria gabbi* Vokes, 1998 was originally described from the coeval Baitoa Formation of the northern Dominican Republic. Vokes (1998) singled out the presence of sharp barbs (prolongations of denticles present within the outer lip) along the margin of the outer lip as the most characteristic feature of this species. Neither of the shells from Cantaure are perfectly preserved; both have the apex missing and the barbs on the outer lip are worn, but the denticles within the outer lip are clearly visible (Fig. 1), and in a similar position to those seen in a specimen of *Lyria gabbi* from the type locality (Fig. 3). Vokes (1998) discussed the presence of a very faint colour pattern on the Dominican shells, consisting of fine spiral lines about 1 mm apart. A similar pattern can be seen on the Cantaure specimens (Fig. 1). The position and character of the axial ornament and denticles on the columellar lip are also identical. *Lyria limata* Hoerle & Vokes, 1978 (Figs 5-6) from the contemporaneous Chipola Formation of NW Florida also has these barbs on the outer lip, but is otherwise not especially similar, with fewer, broader axial ribs and a taller spire.

Later Tropical American *Lyria* species seem to have lost the barbs on the edge of the outer lip. *Lyria*

pulchella (Sowerby, 1850) (Figs 7-8) from the Upper Miocene Cercado, Lower Pliocene Gurabo and Mao formations of the Dominican Republic has quite a different shell shape, with a far more inflated last whorl, less numerous, broader ribs and a thickened, abapically flared outer lip. This is also the only common *Lyria* species in the tropical American deposits. *Lyria incompta* Hoerle & Vokes, 1978 (Figs 9-10), also from the Cercado and Gurabo Formations of the Dominican Republic, but almost totally confined to coralline facies (Vokes 1998), has finer axial sculpture more similar to that of *L. gabbi*, but has a proportionately higher spire. Both *L. pulchella* and *L. incompta* have smooth outer lips, without the barbs seen in *L. gabbi*. For further comparisons see Vokes (1998).

To our knowledge, the two early Miocene *Lyria* species with barbed outer lips are the only tropical American gastropods with this character. In the Recent fauna, barbed lips are confined to the Indo-West Pacific, or to species that have only very recently colonized the eastern Pacific (e.g. *Casmaria vibexmexicana* Stearns, 1894). Barbed lips occur in the strombid genus *Tridentarius* (Kronenberg & Vermeij 2002), the cassid genera *Casmaria* and *Phalium* (see Beu 2008), the mitrid genus *Mitra* (sensu stricto) (Cernohorsky 1976), some species of *Harpa* (see Rehder 1973), and in several nassariids including the genus *Alectrion* (Cernohorsky 1984). The function of these barbs remains unclear, but defence is a distinct possibility, especially in those cassids, strombids, and nassariids in which some of the barbs point anteriorly.

From a paleobiogeographical point of view, the Dominican deposits belong in the West Indian Subprovince, whereas the Cautare deposits are within the Columbian-Venezuelan-Trinidad Subprovince of the Neogene Gatunian Province (see Woodring 1974; Vermeij & Petuch 1986; Landau et al. 2008). We can add *L. gabbi* to the relatively short list of species that occur in both of these paleobiogeographical subprovinces, together with the following species of *Enaeta*, and *Vasum tuberculatum* Gabb, 1873 (Vokes, 1998) and *V. haitense* (G. B. Sowerby I, 1850) (BL coll.).

Genus *Enaeta* H. Adams & A. Adams, 1853

Type species (by subsequent designation, Cossmann 1899): *Voluta harpa* Barnes, 1824 (junior primary homonym of *V. harpa* Mawe, 1823) = *Voluta barnesii* Gray, 1825.

Enaeta inornata n. sp.

Figs 11-16

Type material and dimensions. Holotype NMB H18371, height 30.8 mm, width 15.9 mm (Figs 11-13); paratype 1 NHMW 2009z0078/0001, height 25.0 mm, width 13.2 mm (Figs 14-16); paratype 2 NHMW 2009z0078/0002, height 29.9 mm, width 15.8 mm.

Type locality. Cautare Formation (early Miocene: Burdigalian), Lower shell bed, 1 km southwest of Casa Cautare, about 10 km west of Pueblo Nuevo, Falcón, Venezuela (= locality GS12PGNA of Gibson-Smith & Gibson-Smith 1979).

Diagnosis. An *Enaeta* species with a medium-sized, solid, biconic shell, inflated last whorl and subdued sculpture consisting of weak spiral threads on the spire and six to eight axial ribs, developed only on the mid-portion of the last whorl.

Description. Shell medium-sized for genus, solid, biconic, with inflated last whorl. Protoconch missing. Teleoconch of five whorls with superficial linear suture. Spire short, conical, with periphery at abapical suture. Sculpture on spire of very faint spiral threads, visible only under magnification. Last whorl large, approximately 80% of total height, convex, weakly constricted at base, bearing six to eight relatively broad axial ribs developed only on mid-portion of whorl. Aperture elongate, approximately 55% of total height. Outer lip weakly convex, slightly flared abapically, thickened by labral varix, smooth within, except for one heavy denticle about two-thirds of distance from anterior end to posterior end of lip. Anal canal very narrow, shallow; siphonal canal short, open, narrow, posteriorly recurved. Parietal callus weakly developed immediately adjacent to anal canal, a thin callus wash below; columellar callus very slightly thickened. Columella bearing four strong oblique folds on abapical portion. Siphonal fasciole flattened, separated from base by small ridge of shell.

Discussion. Hoerle & Vokes (1978) and Vokes (1998) considered *Enaeta* to be a subgenus of *Lyria*. However, we follow Poppe & Goto (1992) and Bail & Poppe (2002) and consider the differences between the two sufficiently important to separate them at generic level within the Lyriinae (for discussion on radular characteristics of the group and taxonomic position see Poppe & Goto 1992, p. 19).

Two well-defined *Enaeta* species groups are present in Tropical American Recent and Neogene assemblages. The first is represented in the fossils assemblages by *Enaeta perturbatrix* (Maury, 1917) from the Lower Pliocene Gurabo Formation of the Dominican Republic. It is characterized by an elongate fusiform shell with a high spire and sculpture of numerous, well-developed axial ribs, although they are only well-developed at the periphery on the last whorl. This species is an early representative of the Caribbean group including *E. guildingi* (G. B. Sowerby I, 1844), *E. reevei* Dall, 1907 and *E. leonardhilli* Petuch, 1988 (probably a synonym of *E. guildingi*; Poppe & Goto 1992), which all have the same elongate fusiform shell shape and differ in details of their sculpture. All these species seem to have two stronger anterior folds on the columella and several weaker ones above. *Enaeta trechmanni* Jung,

1971 from the early Middle Miocene Grand Bay Formation (Robinson & Jung 1972; Donovan et al. 2003) probably also belongs in this group. Therefore, this group is recorded earliest in the Atlantic.

The second group also has fusiform shells, although stockier and more solid, with stronger axial sculpture that forms nodules at the shoulder. This is represented in the Recent Caribbean fauna by *Enaeta cylleniformis* (G. B. Sowerby 1, 1844) and in the Recent tropical eastern Pacific fauna by *E. cumingii* (Broderip, 1832). According to Pitt & Pitt (1995), the predecessor of *E. cumingii* is *E. propecuningii* Pitt & Pitt, 1995 from the Upper Miocene Esmeraldas Beds of Ecuador. All these species have three strong abapical folds on the columella and a few weaker folds above. Therefore, this second group is recorded earliest in the Pacific.

Enaeta inornata n. sp. falls into a third group of less well-defined Tropical American species with more ovate shells, having a much larger last whorl and a proportionately shorter spire and rather discrete sculpture. Two fossil species bear some similarity to *E. inornata*: *E. isabellae* (Maury, 1910) [= *Strigatella americana* Dall, 1915, see Gardner 1937] from the Lower Miocene Chipola Formation of northwestern Florida (Figs 17-18) is the most similar in shape, height of spire and size of last whorl. It differs in the character of its ornament, which consists of narrow, weak, close-set axial ribs. *Enaeta economia* Woodring, 1964 from the middle Middle Miocene Lower Gatun Formation of Panama is also similar to our Venezuelan species in shell shape, having a broad, solid last whorl, but is immediately distinguished by its sculpture consisting of about 18 axial ribs on the last whorl and close-set spiral threads covering the entire shell surface. *Enaeta economia* and *E. isabellae* are more similar to each other than they are to *E. inornata*, but *E. economia* has an even broader shell shape, a somewhat coeloconoid spire and fewer, slightly stronger axial ridges than *E. isabellae*. *Enaeta olssoni* Hoerle & Vokes, 1978 also from the Late Miocene middle-upper Gatun Formation of Cativa, Panama, and also known from a single individual, is similar to *E. isabellae*, but has no axial sculpture at all, moreover it has placations on the posterior portion of the columella.

In the Recent faunas there are no representatives of this group in the Caribbean, although *Enaeta barnesii* (Gray, 1825) from the Recent tropical eastern Pacific is similar in having almost no surface sculpture and an inflated last whorl, even more so than any of the fossil forms. All of these species, except *E. olssoni*, have four strongly developed folds on the columella. It is likely that *E. inornata* is more closely related to this Recent tropical eastern Pacific species than to the extant Caribbean forms. However, we stop short of calling them a paciphilic clade (sensu Vermeij & Petuch 1986) as this phylogeny is not indisputable.

From a paleobiogeographical angle, both *Lyria* and *Enaeta* were present in both the Gatunian and

Caloosahatchian Paleobiogeographical provinces during the early Miocene, but subsequently suffered a range contraction so that by the late Miocene-early Pliocene they were only present in the more southern Gatunian Province (see Vermeij & Petuch 1986; Landau et al. 2008).

Etymology. The name reflects the very weak ornament.

ACKNOWLEDGEMENTS

We would like to thank Walter Etter and Olivier Schmidt of the Naturhistorisches Museum Basel (NMB), Switzerland, for access to the Gibson-Smith collection and the loan of type specimens from the Naturhistorisches Museum Basel collection. Dr. Alan G. Beu, GNS Science, Lower Hutt, New Zealand reviewed the MS and made many useful suggestions for improvement.

REFERENCES

- Bail P., Poppe G.T. 2001. A Conchological Iconography: Taxonomic Introduction: Volutidae. Hachenheim, ConchBooks. ii + 30, 5 pls.
- Beu A.G. 2008. Deep-water Cassidae of the world. A revision of *Galeodea*, *Oocorys*, *Sconsia*, *Echinophoria* and related taxa, with new genera and species. In Héros V, Cowie RH, Bouchet P Eds. Tropical deep-sea benthos, volume 14. Mémoires du Muséum National d'Histoire Naturelle 196: 269–387.
- Cernohorsky W.O. 1976. The Mitridae of the World. Part I. The Subfamily Mitrinae. Indo-Pacific Mollusca 3: 273–528.
- Cernohorsky W.O. 1984. Systematics of the family Nassariidae (Mollusca: Gastropoda). Bulletin of the Auckland Institute and Museum 14: 1–356.
- Cossmann M. 1899. Essais de paléoconchologie comparée, vol. 3. Paris, M. Cossmann. 201 p.
- Donovan S.K., Pickerill R.K., Portell R.W., Jackson T.A., Harper D.A. 2003. The Middle Miocene paleobathymetry and paleoenvironments of Carriacou, the Grenadines, Lesser Antilles. Lethaia 36: 255–272.
- Gabb W.M. 1873. On the topography and geology of Santo Domingo. Transactions of the American Philosophical Society 15: 49–259.
- Gardner J. 1937. The molluscan fauna of the Alum Bluff Group of Florida. Part VI. Pteropoda, Opisthobranchia, and Ctenobranchia (in part). United States Geological Survey Professional Paper 142-F: i–iii, 251–435.
- Hoerle S.E., Vokes E.H. 1978. A review of the volutid genera *Lyria* and *Falsilyria* (Mollusca: Gastropoda) in the Tertiary of the western Atlantic. Tulane Studies in Geology and Paleontology 14: 105–130.

- Jung P. 1965. Miocene Mollusca from the Paraguana Peninsula, Venezuela. *Bulletins of American Paleontology* 49(223): 387-644.
- Kronenberg G.C., Vermeij G.J. 2002. *Terestrombus* and *Tridentarius*, new genera of Indo-Pacific Strombidae (Gastropoda), with comments on included taxa and on shell characters in Strombidae. *Vita Malacologica* 1: 49-54.
- Landau B.M., Vermeij G.J., Silva C.M. da 2008. Southern Caribbean Neogene palaeobiogeography revisited. New data from the Pliocene of Cubagua, Venezuela. *Palaeogeography, Palaeoclimatology, Palaeoecology* 257: 445-461.
- Petit R.E. 2009. George Brettingham Sowerby, I, II & III: their conchological publications and molluscan taxa. *Zootaxa* 2189: 1-218.
- Pilsbry H.J. 1922. Revision of W. M. Gabb's Tertiary Mollusca of Santo Domingo. *Proceedings of the Academy of Natural Sciences of Philadelphia* 73: 305-435.
- Pitt W.D., Pitt, L.J. 1995. A new species of *Enaeta* (Gastropoda: Volutidae) from the Mio-Pliocene of northwestern Ecuador. *Tulane Studies in Geology and Paleontology* 28: 123-126.
- Poppe G.T., Goto Y. 1992. *Volutes*. *Mostra Mondiale Malacologia Cupra Marittima* (AP – Italy). Ancona, L'Informatore Piceno. 348 p.
- Rehder H.A. 1973. The family Harpidae of the world. *Indo-Pacific Mollusca* 3: 207-247.
- Robinson E., Jung P. 1972. Stratigraphy and age of marine rocks, Carriacou, West Indies. *Bulletins of the American Associations of Petroleum Geologists* 56: 114-127.
- Saunders J.B., Jung P., Biju-Duval B. 1986. Neogene paleontology in the Northern Dominican Republic. Part I, Field surveys, lithology, environment and age. *Bulletins of American Paleontology* 89(323): 1-79.
- Sowerby GB I 1850. Descriptions of some new species found by J. S. Heniker, esq. In Moore JC. On some Tertiary beds in the Island of San Domingo; from notes by J.S. Heniker, esq., with remarks on the fossils. *Quarterly Journal of the Geological Society of London*, 6: 39-53 [authorship: Petit 2009, p. 200].
- Vermeij GJ, Petuch EJ, 1986. Differential extinction in tropical American molluscs: endemism, architecture, and the Panama land bridge. *Malacologia* 27: 29-41.
- Woodring WP 1974. The Miocene Caribbean Faunal Province and its Subprovinces. *Verhandlungen der Naturforschenden Gesellschaft in Basel* 84: 209-213.

Figures 1-18

1-2. *Lyria gabbi* Vokes, 1998, NHMW 2009z0079/0006 (ex BL coll.), height 33.7 mm, Cantaure Formation (early Miocene: Burdigalian), lower shell bed, Casa Cantaure, Paraguaná Peninsula, Falcón, Venezuela. **3-4.** *Lyria gabbi* Vokes, 1998, NHMW 2009z0079/0001 (ex BL coll.), height 44.3 mm, Baitoa Formation (early Miocene: Burdigalian), E side Rio Yaqué del Norte, just above mouth of Arroyo Hondo, Dominican Republic (= NMB 17290; see Saunders et al. 1986). **5-6.** *Lyria limata* Hoerle & Vokes, 1978, NHMW 2009z0079/0002 (ex BL coll.), height 33.1 mm, Chipola Formation (early Miocene: Burdigalian), Tenmile Creek, 2.8 km W of Chipola River, Calhoun County, Florida (= TU 546; see Hoerle & Vokes 1978). **7-8.** *Lyria pulchella* (Sowerby, 1850), NHMW 2009z0079/0003 (ex BL coll.), height 28.8 mm, Gurabo Formation (early Pliocene: Zanclean), Gurabo River, E bank, first bluff downstream from ford on Los Quemados-Sabaneta road, Dominican Republic (= TU 1210; see Saunders et al. 1986). **9-10.** *Lyria incomperta* Hoerle & Vokes, 1978, NHMW 2009z0079/0004 (ex BL coll.), height 47.0 mm, Cercado Formation (late Miocene: Tortonian), unnamed formation, López area, Rio Yaqué del Norte, Dominican Republic (= NMB 17273; see Saunders et al. 1986). **11-13.** *Enaeta inornata* n. sp., holotype, NMB H18371, height 30.8 mm, Cantaure Formation (early Miocene: Burdigalian), lower shell bed, Casa Cantaure, Paraguaná Peninsula, Falcón, Venezuela. **14-16.** *inornata* n. sp., paratype, NHMW 2009z0078/0001 (ex BL coll.), height 25.0 mm, Cantaure Formation (early Miocene: Burdigalian), lower shell bed, Casa Cantaure, Paraguaná Peninsula, Falcón, Venezuela. **17-18.** *Enaeta isabellae* (Maury, 1910), NHMW 2009z0079/0005 (ex BL coll.), height 33.1 mm, Chipola Formation (early Miocene: Burdigalian), Tenmile Creek, 2.8 km W of Chipola River, Calhoun County, Florida (= TU 546; see Hoerle & Vokes 1978).

